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(71) Applicant: 000006264
Mitsubishi Materials Co., Ltd.
Address: 1-5-1, Ote-machi, Chiyoda-ku, Tokyo
(72) Inventor: Y. Shimura
Address: 2270, Daigaku Yokose, Yokose-machi, Akichichi, Saitama-ken
c/o Mitsubishi Materials Co., Ltd., Ceramics Laboratory
(72) Inventor: H. Hiraoka
Address: 2270, Daigaku Yokose, Yokose-machi, Akichichi, Saitama-ken
c/o Mitsubishi Materials Co., Ltd., Ceramics Laboratory
(74) Patent Representative. Patent Attorney: M. Sugita

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(54) [Title of the Invention] NOISE FILTER

(57) [Abstract]

[Object] The object of the present invention is to remove a high-frequency noise and to provide for a small size and a high-density mounting without crosstalk between a plurality of signal lines.

[Structure] A laminate 65 consists of rectangular dielectric sheets 10, 20, and 30. In the sheet 10, the inner electrodes 11a, 11b are provided on the sheet surface, these inner electrodes being electrically connected to one side of the sheet and having spacers insulating them from the remaining three sides of the sheet. In the sheet 30, an inner electrode 31 is provided on the sheet surface in the same manner as in the sheet 10. In the sheet 20 employed as an intermediate sheet, an earth electrode 23 is provided on the sheet surface, this earth electrode being insulated from a pair of sides corresponding to those sides of the sheets 10 and 30 to which the inner electrodes are connected and being connected to other pair of sides. A capacitance is formed between the inner electrode and earth electrode via the sheet 20 or 30. The signal electrodes 51, 52 connected

to the inner electrodes, and the ground electrodes 53, 54 connected to the earth electrode are formed on the side surfaces of the laminate independently from each other.

[Patent Claims]

[Claim 1] A noise filter comprising a laminate (65, 115) obtained by laminating a set or no less than two sets each containing a rectangular 2nd dielectric sheet (20, 70) as an intermediate sheet, a 1st dielectric sheet (10, 60) having the same shape and size as said sheet (20, 70), and a 3rd dielectric sheet (30, 80) having the same shape and size as said sheet (20, 70), laminating a 4th dielectric sheet (40, 90) as the outermost layer, this 4th dielectric sheet having no electrodes formed on the its surface, and integrating the sheets, wherein

in said 1st dielectric sheet (10, 60), a 1st inner electrode (11a, 11b, 61) which is electrically connected to one side and has spacers (12, 13, 14, 62, 63, 64) electrically insulating it from the remaining three sides is provided on the sheet surface,

in said 3rd dielectric sheet (30, 80), a 2nd inner electrode (31, 81) which is electrically connected to one side that is opposite to a side corresponding to the side of the 1st dielectric sheet (10, 60) to which said 1st inner electrodes (11a, 11b, 61) were electrically connected, and having spacers (32, 33, 34, 82, 83, 84) electrically insulating it from the remaining three sides is provided on the sheet surface,

in said 2nd dielectric sheet (20, 70), an earth electrode (23, 73) which has spacers (21, 22, 71, 72) electrically insulating it from a pair of sides corresponding to those sides of the 1st and 3rd dielectric sheets (10, 30, 60, 80) which are electrically connected to said 1st and 2nd inner electrodes (11a, 11b, 31, 61, 81) and is electrically connected to a pair of sides other than the aforesaid pair of sides is provided on the sheet surface,

respective capacitance is formed between said 1st inner electrode (11a, 11b, 61) and said earth electrode (23, 73) via said 2nd dielectric sheet (20, 70), and between said 2nd inner electrode (31, 81) and said earth electrode (23, 73) via said 3rd dielectric sheet (30, 80),

1st and 2nd signal electrodes (51, 51, 52, 101, 102) electrically connected to respective said 1st and 2nd inner electrodes (11a, 11b, 31, 61, 81) exposed on the side surface of said laminate (65, 115) are formed on those side surfaces, and

ground electrodes (53, 54, 103, 104) connected to said earth electrode (23, 73) exposed on other both side surfaces of said laminate (65, 115) are formed on both those side surfaces or on any one side surface of those two side surfaces.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Utilization] The present invention relates to a noise filter for removing high-frequency noise in a plurality of signal lines. More specifically, the present invention relates to a noise filter consisting of a multilayer chip capacitor suitable for preventing crosstalk between a plurality of lines.

[0002]

[Prior Art Technology] Digital devices such as computers can easily malfunction when a high-frequency noise penetrates into a signal line. Another problem associated with such devices is that unnecessary electromagnetic waves which can damage other electronic devices are emitted from the wiring. For this reason, noise filters using capacitor elements to remove a high-frequency noise have been widely used in signal lines. Examples of such noise filters include single-sheet capacitors, two-terminal laminated chip capacitors, through-type capacitors, and through-type capacitor arrays. Single-sheet capacitors, two-terminal laminated chip capacitors, and through-type capacitors have been used at a ratio of one capacitor per line, whereas the through-type capacitor arrays comprising a plurality of capacitors can be used for a plurality of signal lines.

[0003]

[Problems Addressed by the Present Invention] However, The single-sheet capacitors, two-terminal laminated chip capacitors, through-type capacitors, and through-type capacitor arrays have the following drawbacks.

(1) In single-sheet capacitors, outer electrodes are provided on both surfaces of a disk-like capacitor element, and a pair of lead wires are connected thereto. Because of such a structure, the single-sheet capacitors cannot be mounted with a high density onto a circuit substrate and electronic devices are difficult to miniaturize. Furthermore, when the capacitor is mounted onto a circuit substrate, since it contains lead wires, the equivalent circuit obtained when a single-sheet capacitor is connected between a signal line 2 of the circuit substrate and ground 3 is approximated by LC series resonance circuit and cannot function as a noise filter at a frequency above a certain threshold frequency.

(2) The two-terminal laminated chip capacitor comprises a laminate obtained by preparing two rectangular ceramic sheets forming an assembly, these sheets having inner electrodes formed on their surface so that the electrodes extend to one external side of the sheet and are separated from the external side of the sheet on the opposite side from the above-mentioned external side of the sheet, laminating the two ceramic sheets so that external sides of the sheets to which the internal electrodes are extended become at the opposite sides, and further laminating and integrating the resulting assemblies of ceramic sheets, and a pair of external electrodes (two terminal electrodes) formed so as to be connected to the inner electrodes exposed on the respective side surfaces of the laminate. Such a multilayer chip capacitor makes it possible to obtain a higher density of mounting on a circuit substrate than the single-sheet capacitors, but always requires wiring to a ground point or inner electrodes of the capacitor. For this reason, the circuit containing such a capacitor is approximated by the LC series resonance circuit shown in Fig 13, similarly to the single-sheet capacitor, and cannot function as a noise filter at a frequency above a certain threshold frequency.

[0004] (3) In the through-type capacitors, a through opening via which a signal line is passed is formed in the center of a capacitor element, for example, having a disk-like shape, a 1st conductor layer connected to the signal line is formed on the periphery of the through opening on one surface of the capacitor element, a 2nd conductor layer for grounding is formed on the other surface of the capacitor element and on the external surface thereof so that it is separated from

the first conductor layer, and a capacitance is formed between the 1^{st} conductor layer and 2^{nd} conductor layer via the capacitor element. When the through-type capacitor is mounted onto a circuit substrate, no lead wire or wiring has to be led as required by the structure of single-sheet capacitors or two-terminal multilayer chip capacitors, and the capacitor circuit can be approximated by the perfect circuit shown in Fig 12. However, the specific structure of the through-type capacitors hinders a high-density mounting on circuit substrates and makes it difficult to decrease the size of electronic devices. Furthermore, mounting becomes a labor-consuming operation and mounting cost is increased.

[0005] (4) In a through-type capacitor array, a plurality of through openings through which the respective signal lines are passed are formed in a capacitor element, for example, having a rectangular shape, 1^{st} conductors connected to the signal lines are formed on the periphery of the through openings on one surface of the capacitor element, a 2^{nd} conductor layer for grounding is formed on the other surface of the capacitor element and on the external surface thereof so that it is separated from the first conductors, and a capacitance is formed between the 1^{st} conductor layer and 2^{nd} conductor layer via the capacitor element. In the through capacitor array, the circuit can be made similar to the perfect circuit shown in Fig 12, for the same reason as was applied to the through capacitor, and the drawbacks inherent to the through capacitor, that is, difficulty in increasing the density and raised mounting cost can be resolved. However, in the through capacitor array, a plurality of through openings are formed close to each other, and conductors such as lead wires are passed through each opening. As a result, if the space between the through openings is made too small to decrease the spacing between the 1^{st} conductors, when high-frequency signals are supplied into the signal lines such as lead wires, due to a floating capacitance existing between the two neighboring 1^{st} conductors, a noise with a frequency above a certain preset frequency is transmitted and crosstalk can easily occur. For this reason, a certain limit was placed on the degree of density increase in order to prevent the crosstalk.

[0006] It is an object of the present invention to provide a small noise filter which can remove a high-frequency noise and can be mounted to a high degree of density. It is another object of the present invention to provide a noise filter which makes it possible to conduct mounting at a low cost. It is still another object of the present invention to provide a noise filter in which a crosstalk between a signal passing through each signal line and another line is reliably prevented even when inner electrodes connected to a plurality of signal lines are arranged with a high density.

[0007]

[Means to Resolve the Problems] The structure of the present invention developed to attain the above-described objects will be explained below with reference to Figs 1 to 4. In order to facilitate the explanation, ceramic sheet portions in Figs 1, 2, and 4 are expanded in the thickness direction. The noise filter in accordance with the present invention comprises a laminate 65 obtained by laminating a set or no less than two sets each containing a rectangular 2^{nd} dielectric sheet 20 as an intermediate sheet, a 1^{st} dielectric sheet 10 having the same shape and size as the sheet 20, and a 3^{rd} dielectric sheet 30 having the same shape and size as the sheet 20, laminating a 4^{th} dielectric sheet 40 as the outermost layer, this 4^{th} dielectric sheet having no electrodes formed on its surface, and integrating the sheets. In the 1^{st} dielectric sheet 10, the 1^{st} inner electrodes 11a, 11b which are electrically connected to one side and have spacers 12, 13, 14

electrically insulating them from the remaining three sides are provided on the sheet surface. In the 3rd dielectric sheet 30, a 2nd inner electrode 31 which is electrically connected to one side that is opposite to a side corresponding to the side of the 1st dielectric sheet 10 to which the 1st inner electrodes 11a, 11b were electrically connected, and having spacers 32, 33, 34 electrically insulating it from the remaining three sides is provided on the sheet surface. In the 2nd dielectric sheet 20, an earth electrode 23 which has spacers 21, 22 electrically insulating it from a pair of sides corresponding to those sides of the 1st and 3rd dielectric sheets 10, 30 which are electrically connected to the 1st and 2nd inner electrodes 11a, 11b, 31 and is electrically connected to a pair of sides other than the aforesaid pair of sides is provided on the sheet surface. Respective capacitance is formed between the 1st inner electrodes 11a, 11b and the earth electrode 23 via the 2nd dielectric sheet 20, and between the 2nd inner electrode 31 and the earth electrode 23 via the 3rd dielectric sheet 30. The 1st and 2nd signal electrodes 51, 52 electrically connected to respective 1st and 2nd inner electrodes 11a, 11b, 31 exposed on the side surface of the laminate 65 are formed on those side surfaces. The 1st and 2nd ground electrodes 53, 54 connected to the earth electrode 23 exposed on other both side surfaces of the laminate 65 are formed on both those side surfaces. Furthermore, any one electrode of the ground electrodes 53, 54 may be provided on one side surface of the laminate.

[0008]

[Operation] The earth electrode 23 is connected via the ground electrodes 53, 54 between the 1st inner electrodes 11a, 11b located on the 1st dielectric sheet 10 and 2nd inner electrode 31 located on the 3rd dielectric sheet 30. As a result, the floating capacitance between the neighboring signal lines is substantially eliminated and crosstalk between the signal and noise lines can be cancelled. Furthermore, since a respective capacitance is formed between the 1st inner electrodes 11a, 11b and the earth electrode 23 via the 2nd dielectric sheet 20, and between the 2nd inner electrode 31 and the earth electrode 23 via the 3rd dielectric sheet 30, a difference in potential is generated between the inner electrodes 11a, 11b, 31 which are in a conductive state and the earth electrode 23, a capacitor function is realized, and a high-frequency noise is absorbed.

[0009]

[Embodiments] Embodiments of the present invention will be explained below. Those embodiments place no limitation on the present invention.

<Embodiment 1> A noise filter of Embodiment 1 will be described below with reference to Figs 1 to 5. First, four ceramic green sheet of the same shape and size were prepared. Those ceramic green sheets were referred to as the 1st ceramic green sheet, 2nd ceramic green sheet, 3rd ceramic green sheet, and 4th ceramic green sheet, respectively. The ceramic green sheets can be formed, by coating, for example, a barium titanate dielectric slurry having a JIS-R characteristic by a doctor blade method on the upper surface of a polyester base sheet and drying.

[0010] Then, an electrically conductive paste containing Pd as the main component was screen printed according to respective patterns onto the front surface of the 1st ceramic green sheet, 2nd ceramic green sheet, and 3rd ceramic green sheet, followed by drying for 4 min at a temperature of 80°C. Thus, as shown in Fig 3, the 1st inner electrodes 11a, 11b were formed by printing of the

1st ceramic green sheet 10, those electrode being electrically connected to one side of the sheet and having spacers 12, 13, 14 electrically insulating them from three remaining sides of the sheet. An earth electrode 23 was formed by printing on the 2nd ceramic green sheet 20, this earth electrode 23 having portions which overlap the inner electrodes 11a, 11b formed on the 1st ceramic green sheet 10 after lamination, having spacers 21, 22 electrically insulating it from a pair of sides, and being electrically connected to a pair of sides other than the above-mentioned pair of sides. Furthermore, a 2nd inner electrode 31 was formed by printing on the 3rd ceramic green sheet 30, this 2nd inner electrode 31 having a portion which overlaps the earth electrode 23 formed on the 2nd ceramic green sheet after lamination, being electrically connected to one side of the sheet which is opposite to one side corresponding to the side of the 1st ceramic green sheet 10 to which the 1st inner electrodes 11a, 11b were electrically connected, and having spacers 32, 33, 34 electrically insulating it from the three remaining sides.

[0011] The three screen printed sheets, that is the 1st ceramic green sheet 10, 2nd ceramic green sheet 20, and 3rd ceramic green sheet 30 were successively laminated, and then a 4th ceramic green sheet 40 that was not printed with the electrically conductive paste was laminated as the upper most layer. Those green sheets represent the dielectric sheets in accordance with the present invention. The laminate 65 shown in Fig 4 was integrated by thermal fusion under pressure and then fired for about 1 h at a temperature of 1300°C to obtain a sintered body having a thickness of about 1 mm. As shown in Fig 4, this sintered body was barrel polished to expose the 1st inner electrodes 11a, 11b, 2nd inner electrode 31 (not shown in Fig 4), and earth electrode 23 on the side surfaces of the sintered body.

[0012] Then, as shown in Fig 5, an electrically conductive paste containing Ag as the main component was coated on the portions of the side surfaces of the sintered body where the inner electrodes 11a, 11b, 31 and earth electrode 23 were exposed. The paste was fired to form signal electrodes 51, 51, 52 and ground electrodes 53, 54. As a result, a noise filter was obtained in which the 1st inner electrodes 11a, 11b were electrically connected to the 1st signal electrode 51, the 2nd inner electrode 31 was electrically connected to the 2nd signal electrode 52, and the earth electrode 23 was electrically connected to the 1st and 2nd ground electrodes 53, 54. An equivalent circuit of this noise filter is shown in Fig 10. In Fig 10 and Fig 5, the same structural elements are represented by the same reference symbols.

[0013] In order to study characteristics of this noise filter, it was mounted on a separately prepared printed substrate 55. Three signal lines 56a, 56b, and 57 were print wired to the upper surface of the printed substrate 55, and ground electrodes 58, 59 were formed on their both sides. Through holes 58a and 59a were provided in the electrodes 58 and 59, and the electrodes 58 and 59 were electrically connected to the ground electrode 55a formed over almost the whole lower surface of substrate 55 via the through holes 58a and 59a. The signal electrodes 51, 51 were soldered to the signal lines 56a, 56b, respectively. The signal electrode 52 was soldered to the signal line 57, and the ground electrodes 53, 54 were soldered to the ground electrodes 58, 59.

[0014] In such a state, a high-frequency signal was input from one end of signal lines 56a, 56b, and 57, output signals were measured at the other ends and an insertion loss was determined. The results obtained demonstrated, that the insertion loss rapidly increased with the increase in frequency, and the noise filter had good filter characteristic. Then, the existence of crosstalk was

studied by measuring output signals at the other ends of the neighboring signal lines 56a, 57 and at the other ends of signal lines 56b, 57. The crosstalk was so small that could not be detected, and a significant improvement was observed over the results obtained for the conventional noise filter.

[0015] <Embodiment 2> The noise filter of Embodiment 2 will be described below with reference to Figs 6 to 9. The reference symbols representing structural parts in those figures which correspond to the structural parts of Embodiment 1 were obtained by adding 50 to the respective reference symbols used in Embodiment 1. First, similarly to Embodiment 1, four ceramic green sheet of the same shape and size were prepared. Those ceramic green sheets were referred to as the 1st ceramic green sheet, 2nd ceramic green sheet, 3rd ceramic green sheet, and 4th ceramic green sheet, respectively.

[0016] Then, an electrically conductive paste containing Pd as the main component was screen printed according to respective patterns onto the front surface of the 1st ceramic green sheet, 2nd ceramic green sheet, and 3rd ceramic green sheet, followed by drying for 4 min at a temperature of 80°C. Thus, as shown in Fig 7, a 1st inner electrode 61 was formed by printing of the 1st ceramic green sheet 60, this electrode being electrically connected to one side of the sheet and having spacers 62, 63. 64 electrically insulating it from three remaining sides of the sheet. An earth electrode 73 was formed by printing on the 2nd ceramic green sheet 70, this earth electrode 73 having a portion which overlaps the inner electrode 61 formed on the 1st ceramic green sheet 60 after lamination, having spacers 71, 72 electrically insulating it from a pair of sides, and being electrically connected to a pair of sides other than the above-mentioned pair of sides. Furthermore, a 2nd inner electrode 81 was formed by printing on the 3rd ceramic green sheet 80, this 2nd inner electrode 81 being electrically connected to one side of the sheet which is opposite to one side corresponding to the side of the 1st ceramic green sheet 60 to which the 1st inner electrode 61 was electrically connected, and having spacers 82, 83, 84 electrically insulating it from the three remaining sides.

[0017] The three screen printed sheets, that is the 1st ceramic green sheet 60, 2nd ceramic green sheet 70, and 3rd ceramic green sheet 80 were successively laminated in the same manner as in Embodiment 1, and then a 4th ceramic green sheet 90 that was not printed with the electrically conductive paste was laminated as the uppermost layer. The laminate was integrated by thermal fusion under pressure. Firing of the laminate 115 shown in Fig 8 was conducted in the same manner as in Embodiment 1. The sintered body was barrel polished to expose the 1st inner electrode 61, 2nd inner electrode 81 (not shown in Fig 8), and earth electrode 73 on the side surfaces of the sintered body.

[0018] Then, as shown in Fig 5, an electrically conductive paste containing Ag as the main component was coated in the same manner as in Embodiment 1 on the portions of the side surfaces of the sintered body where the inner electrodes 61, 81 and earth electrode 73 were exposed. The paste was fired to form signal electrodes 101, 102 and ground electrodes 103, 104. As a result, a noise filter was obtained in which the 1st inner electrode 61 and 2nd inner electrode 81 were electrically connected to the 1st and 2nd signal electrodes 101, 102, and the earth electrode 73 was electrically connected to the 1st and 2nd ground electrodes 103, 104. An

equivalent circuit of this noise filter is shown in Fig 11. In Fig 11 and Fig 9, the same structural elements are represented with the same reference symbols.

[0019] This noise filter was mounted on a separately prepared printed substrate, and its characteristics were studied in the same manner as in Embodiment 1. A high-frequency signal was input from one end of a signal line (not shown in the figures) connected to the signal electrode 101 or 102, output signals were measured at the other end, and an insertion loss was determined. The results obtained demonstrated, that the insertion loss rapidly increased with the increase in frequency, and the noise filter also had a good filter characteristic. Then, the existence of crosstalk was studied by measuring an output signals at the other end of a signal line (not shown in the figure) connected to the signal electrode 101 or 102 . The crosstalk was so small that could not be detected, and a significant improvement was observed over the results obtained for the conventional noise filter.

[0020] In the above-described Embodiment 1 and Embodiment 2, only one 1st, 2nd, and 3rd ceramic green sheet was used for lamination. Hover, no limitation is placed on the number of 1st ceramic green sheets, 2nd ceramic green sheets, and 3rd ceramic green sheets in the laminate in accordance with the present invention. Thus, by appropriately increasing the number of laminated layers it is possible to vary the capacitance formed by the inner electrodes and earth electrodes and change the insertion loss. Furthermore, in Embodiment 1, two 1st inner electrodes and one 2nd inner electrode were employed. However, no limitation is placed on the number of 1st and 2nd inner electrodes and their number can be greater than that in Embodiment 1. When a plurality of inner electrodes are provided on each sheet, it is preferred that the inner electrodes be arranged in such a manner that the inner electrode on one sheet be positioned between the neighboring inner electrodes on the other sheet. Such a configuration of inner electrodes effectively prevents crosstalk. Furthermore, in Embodiment 1 and Embodiment 2, the respective ground electrodes 53, 54 and 102, 104 were provided on both side surfaces of the sintered body. However, one ground electrode may be formed on one side surface of the sintered body.

[0021]

[Effect of the Invention] As described above, in accordance with the present invention, no less than two signal electrodes are electrically connected to signal leads or signal lines employed for signal transmission and the ground electrode is grounded. As a result, a capacitance is formed between the 1st inner electrodes located on the 1st dielectric sheet and the earth electrode located on the 2nd dielectric sheet, and between the 2nd inner electrode located on the 3rd dielectric sheet and the earth electrode located on the 2nd dielectric sheet, which makes it possible to remove a high-frequency noise penetrating into the signal lines and the like. Furthermore, since an earth electrode is installed between the 1st inner electrode and 2nd inner electrode and this earth electrode is grounded via a ground electrode, the floating capacitance is removed with a higher reliability even when a high-frequency signal is supplied into the signal lines, and mutual crosstalk between the neighboring signal lines can be prevented. In particular, by contrast with the conventional two-terminal multilayer chip capacitors, the noise filter in accordance with the present invention is composed of a multiterminal multilayer chip capacitor. As a result, it is not necessary to install a noise filter on each signal line, and one noise filter becomes sufficient for a

plurality of signal lines. Therefore, the noise filter in accordance with the present invention has small size, can be mounted at a high density and provides for a reduced mounting cost.

[Brief Description of the Drawings]

Fig 1 is a cross section along line A-A in Fig 5 showing a noise filter which is an embodiment of the present invention.

Fig 2 is a cross section along line B-B relating to the above-mentioned embodiment.

Fig 3 is a perspective view of the laminate prior to lamination.

Fig 4 is a perspective view of a sintered body obtained by sintering the laminate.

Fig 5 is a perspective view of a noise filter mounted on a printed circuit substrate.

Fig 6 is a cross section along line C-C in Fig 5 showing a noise filter which is another embodiment of the present invention.

Fig 7 is a perspective view of the laminate prior to lamination.

Fig 8 is a perspective view of a sintered body obtained by sintering the laminate.

Fig 9 is a perspective view of the respective noise filter.

Fig 10 is an equivalent circuit of the noise filter shown in Fig 5.

Fig 11 is an equivalent circuit of the noise filter shown in Fig 9.

Fig 12 is an equivalent circuit of an ideal capacitor containing no inductance component.

Fig 13 is an equivalent circuit approximating the LC series resonance circuit.

[Legends]

10, 60 – 1st dielectric sheet (1st ceramic green sheet).
11a, 11b, 61 – 1st inner electrode.
12, 13, 14, 62, 63, 64 – electrically insulating spacers.
20, 70 – 2nd dielectric sheet (2nd ceramic green sheet).
21, 22, 71, 72 – electrically insulating spacers.
23, 73 – earth electrode.
30. 80 – 3rd dielectric sheet (3rd ceramic green sheet).
31, 81 – 2nd inner electrode.
32, 33, 34, 82, 83, 84 – electrically insulating spacers.
40, 90 – 4th dielectric sheet (4th ceramic green sheet)
51, 101 – 1st signal electrode.
52, 102 – 2nd signal electrode.
53, 103 – 1st ground electrode.
54, 104 – 2nd ground electrode.
65, 115 – laminate.

Fig 1

10 – 1st dielectric sheet (1st ceramic green sheet).
11a, 11b – 1st inner electrode.
12, 14 – electrically insulating spacers.
20 – 2nd dielectric sheet (2nd ceramic green sheet).
23 – earth electrode.

30 – 3rd dielectric sheet (3rd ceramic green sheet).
31 – 2nd inner electrode.
32, 34 – electrically insulating spacers.
40 – 4th dielectric sheet (4th ceramic green sheet)
53 – 1st ground electrode.
54 – 2nd ground electrode.

Fig 2

Fig 3

Fig 4
65 – laminate

Fig 5

Fig 6
60 – 1st dielectric sheet (1st ceramic green sheet).
61 – 1st inner electrode.
64 – electrically insulating spacers.
70 – 2nd dielectric sheet (2nd ceramic green sheet).
73 – earth electrode.
80 – 3rd dielectric sheet (3rd ceramic green sheet).
81 – 2nd inner electrode.
84 – electrically insulating spacers.
90 – 4th dielectric sheet (4th ceramic green sheet)
101 – 1st signal electrode.
102 – 2nd signal electrode.

Fig 7

Fig 8
115 – laminate

Fig 9

Fig 10

Fig 11

Fig 12

Fig 13

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(72) Inventor: Y. Ikematsu
Address: 972, Urasa, Owa-machi, Minamiuonuma, Niigata-ken
c/o Mitsubishi Materials Co., Ltd., Ceramics Laboratory, Urasa branch

(72) Inventor: A. Uchida
Address: 972, Urasa, Owa-machi, Minamiuonuma, Niigata-ken
c/o Mitsubishi Materials Co., Ltd., Ceramics Laboratory, Urasa branch

(72) Inventor: Y. Koshima
Address: 972, Urasa, Owa-machi, Minamiuonuma, Niigata-ken
c/o Mitsubishi Materials Co., Ltd., Ceramics Laboratory, Urasa branch